

CJS Labs

Technology · Research · Strategy · Solutions

Lab Notes



Audio & Electroacoustics

- Consulting
- Design / Testing
- Training

Volume 3, Issue 1

February 2010

© 2010 CJS Labs

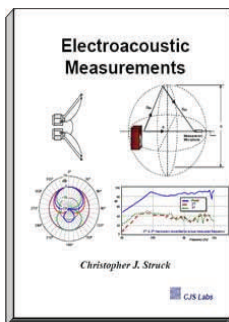
Inside this issue:

Project Work for 2010	1
Recent News & Upcoming Events	
AudiologyNOW!®2010	1
AES News	1
Electroacoustic Measurements Book	1
Noise Isolation Measurements	2

“Electroacoustic Measurements” Book

THE essential reference for making proper electroacoustical transducer measurements. A 300+ page, bound, fully annotated compendium of slides and notes from the CJS Labs training seminars. Literature references for each chapter are also included. Ordering information:

<http://www.cjs-labs.com/sitebuildercontent/sitebuilderfiles/OrderingCourseNotes.pdf>



Project Work for 2010

A visit to the Smithsonian in Washington DC last fall inspired me to investigate the operating principles of the phonograph cartridge, essentially a dual orthogonal velocity probe. Vinyl is apparently still quite big in



the audiophile and collector circles! The photo is of the 1899 Edison cylinder player.

Many industries are still feeling the effects of the economic decline in 2009. CJS Labs was no exception, with a noticeable decline in new projects. Fortunately we have weathered the storm and are currently busy with several interesting projects, involving both hardware and software development. A list of recent project work is avail-

able on our website at:

<http://www.cjs-labs.com/sitebuildercontent/sitebuilderfiles/CJSLabsRecentProjectList.pdf>

Meanwhile, we still offer seminars and training as well as the “Electroacoustic Measurements” seminar notes, available from our website (see sidebar for more information).

Please contact us and let us know how we can be of service to you and your organization.

Recent News & Upcoming Events

Standards News

Several IEEE telecom standards, including 269 and 1329, are currently out for ballot and should be available later this year. Stay tuned for updates.

Convention will be here in San Francisco this fall. More info will be available at the AES website later this spring.

We plan to attend. Please contact us if you would like to set up a meeting.

AES News

In 2009, I became a reviewer for the AES Journal. Although a volunteer assignment, I found the process very interesting and was pleased to help improve the quality of the technical articles in the JAES. The AES 129th

American Academy of Audiology: Audiology NOW!® 2010

AudiologyNOW!® 2010, the annual conference for the American Academy of Audiology, will be held in San Diego, 14-17 April 2010. More info at:

<http://www.audiologynow.org/>

Best regards,

Christopher J. Struck

CEO & Chief Scientist

CJS Labs





CJS Labs

“Sound Advice since 1986”

57 States Street
San Francisco, CA 94114-1401
USA

Tel: +1 415 923-9535
E-mail: cjs@cjs-labs.com



National Council of
Acoustical Consultants
Member

CJS Labs is a consulting firm based in San Francisco, California. We specialize in audio and electroacoustics applications. With over 24 years of industry experience in engineering and technology management, our areas of expertise include transducers, acoustics, system design, instrumentation, measurement and analysis techniques, hearing science, telephonometry, speech intelligibility, and perceptual coding. We also offer project management, technology strategy, and training services

Back issues of Lab Notes are available on our website at:
<http://www.cjs-labs.com/id5.html>

Noise-Canceling Headphones & Headsets: Measurement of Passive and Active Noise Isolation

Measurement of Noise Isolation is performed as an Insertion Loss (substitution) test. First, the background noise level in the test space is checked. This should be at least 10 dB below any subsequently measured level in each band. Next, the spectrum and level are verified. Although a perfectly flat spectrum is not required, sufficient stimulus is required in all bands, across the entire bandwidth of interest. Again, 1/3 octave bands are preferred, but the measurement can be performed with an FFT and then processed (power summed) to obtain the equivalent 1/3 octave spectrum. Using FFT, two passes may be required to obtain sufficient resolution at low frequencies. A typical test level is 90 dB SPL, so use hearing protection if you are in the same room! Ideally, a reverb chamber would be used, but good results can be obtained as long as the spectrum is uniform. The manikin is placed into the sound field, with the centre of the head at the reference point where the acoustic test spectrum was verified. The open ear response is then measured.

The actual noise isolation can then be computed from the acquired data as follows:

$$L_{Passive}(f) = G_1(f) - G_{Open Ear}(f) \text{ [in dB]} \quad (Eq. 1)$$

$$L_{Active + Passive}(f) = G_2(f) - G_{Open Ear}(f) \text{ [in dB]} \quad (Eq. 2)$$

$$L_{Active}(f) = L_{Active + Passive}(f) - L_{Passive}(f) \text{ [in dB]} \quad (Eq. 3)$$

If the data was obtained via narrow band FFT, the spectra should be power summed into 1/3 octaves. This reduces narrowband calculation errors, improves the data visualization, and also correlates well to loudness and hearing, as the width of a critical band is approximately 1/3 octave above 400 Hz. The passive attenuation (plotted as gain) is $G_1(f)$ minus the open ear response (in dB). The total attenuation (passive and active) is $G_2(f)$ minus the open ear response (in dB). Since the passive attenuation cannot be switched off (!), the contribution of the active noise cancellation must be “backed out” of the overall level by subtracting the calculated passive attenuation from the total attenuation (in dB), as shown.

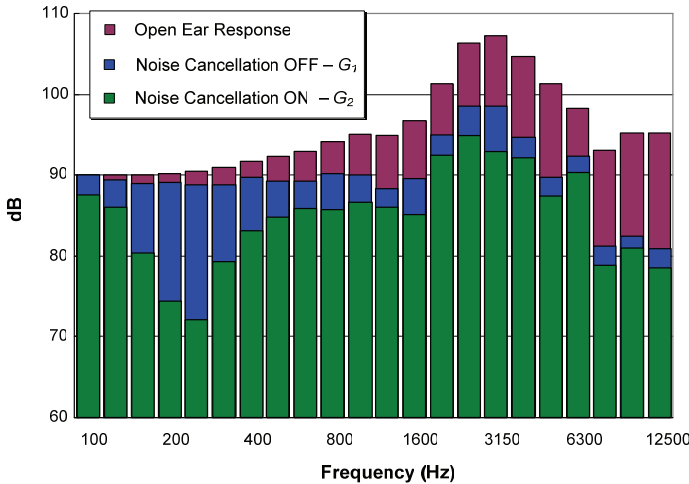


Fig. 1 — Noise spectra: Manikin open ear, Passive earphone $G_1(f)$, Earphone with Active Noise Cancellation $G_2(f)$.

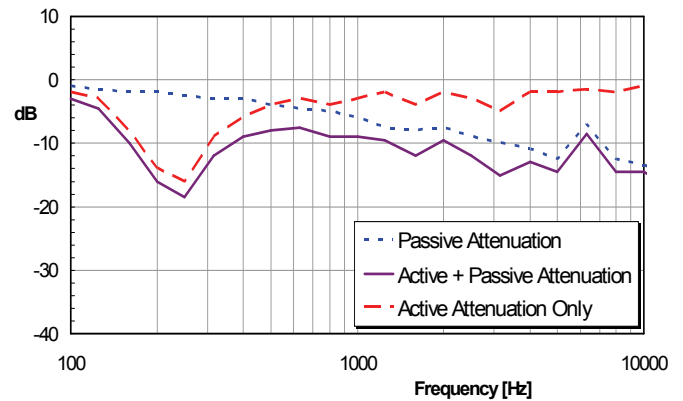


Fig. 2 Passive and active noise isolation.

Next, the headphones or headset under test are placed on the manikin and the test is repeated. This gives the test spectrum $G_1(f)$. If the headphones incorporate active noise cancellation, this should then be switched on and the test repeated to obtain the second spectrum $G_2(f)$.

Typically, the active cancellation is more effective at low frequencies, where the wavelength of sound is long, while the passive attenuation is greater at high frequencies where occlusion and absorption are more effective.

Contact us for more information.